

MU123

TMA 03

2019B

Covers Units 6, 7, 8 and 9

Cut-off date 25 June 2019

Submission instructions

You will find instructions for completing TMAs in the ‘Assessment’ area of the MU123 website. Please read these instructions before beginning work on this TMA.

Reviewing your tutor’s comments on your previous TMA will help you as you work on this one.

Special instructions

Remember that you need to explain your reasoning and communicate your ideas clearly, as described in Subsection 5.3 of Unit 1. This includes:

- explaining your mathematics in the context of the question
- the correct use of notation and units
- appropriate rounding.

Your score out of 5 for good mathematical communication (GMC) will be recorded against Question 7. You do not have to submit any work for Question 7.

Question 1 – 10 marks

This question is based on your work on MU123 up to and including Unit 6.

- (a) Figure 1 shows two points A and B with a straight line drawn through them.

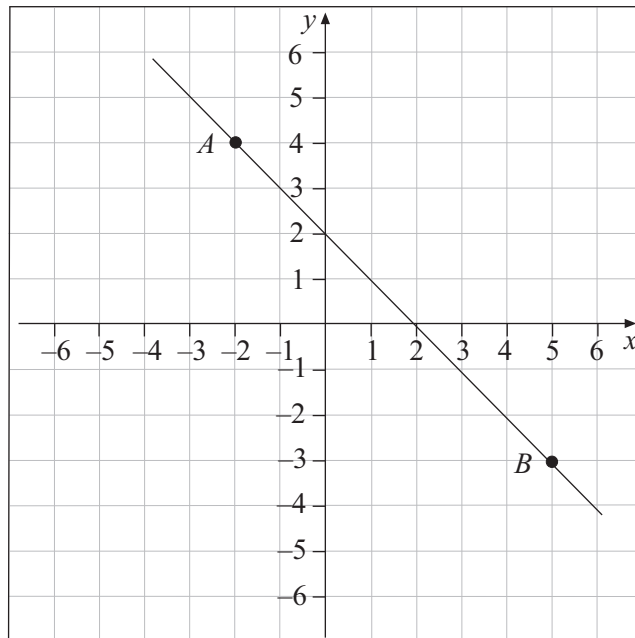


Figure 1

- (i) Write down the coordinates of the points A and B . [1]
- (ii) Find the gradient of the line that passes through the points A and B , clearly showing each step of your method. [2]
- (b) (i) Find the equation of the line that passes through the point $(-2, 5)$ and has slope $\frac{5}{4}$. [3]
- (ii) Determine whether or not the point $(-3, 4)$ lies on the line found in part (b)(i), clearly showing each step of your method. [2]
- (iii) Find the x -intercept of the line found in part (b)(i), clearly showing each step of your method. [2]

Question 2 – 15 marks

This question is based on your work on MU123 up to and including Unit 6.

This question investigates the relationship between the number of hours spent studying in the four-week period before an exam and the marks achieved in the exam. Based on data collected from a group of students, a scatterplot was produced with the regression line included. The number of study hours was displayed on the horizontal axis, and the marks achieved in the exam was displayed on the vertical axis.

- (a) Describe three features of a scatterplot that might help us to explain the relationship between the two variables being investigated. [6]
- (b) The regression line for the investigation is $y = 1.42x + 12.67$. What do the x and y variables represent here? [2]
- (c) The correlation coefficient r for the investigation is 0.95. What does this tell you? [2]
- (d) Use the regression equation from part (b) to predict the exam score of a student who spends 47 hours studying in the four-week period before the exam. Give your answer to the nearest whole mark. [2]
- (e) Can you conclude from this investigation that the number of hours that a student spends studying in the four-week period before the exam determines the marks that the student will achieve in the exam? Explain your answer. [2]
- (f) If the correlation coefficient for this investigation had been 0.99, would this have changed the answer that you gave to part (e)? Explain your reasoning. [1]

Question 3 – 5 marks

This question is based on your work on MU123 up to and including Unit 7.

Make k the subject of the following two equations. Show each step of your working.

- (a) $3t = \frac{9k}{13} - 7$ [2]
- (b) $9k = \frac{11k}{4t} + 11t$ [3]

Question 4 – 20 marks

This question is based on your work on MU123 up to and including Unit 7.

Keith is organising a go-karting day out with friends. He has two options, which both offer packages for groups of up to 20. Venue A charges £12.50 per person and a non-refundable booking deposit of £200. Venue B charges £25 per person and a non-refundable booking deposit of £25.

- (a) Copy and complete Table 1 by working out how much it costs to go to each venue for the numbers attending shown.

Table 1 Total cost in pounds for each option

Number attending	8	12	20
Venue A			450
Venue B			525

[2]

- (b) The linear equation $y = 12.5x + 200$ can be used to calculate the total cost y (in pounds) for x people attending if Keith chooses Venue A. Explain why this equation holds. Write down a similar equation that can be used to give the total cost y (in pounds) for x people attending if Keith chooses Venue B.

[2]

- (c) (i) Using the same axes, draw graphs of the two equations from part (b). Use an x -scale from 0 to 20, and choose a y -scale that allows both lines to be seen over this range.

You may draw your graphs by hand, using squared paper, or use Graphplotter and send a printout with the rest of your TMA. Remember to label the lines with their equations.

[4]

- (ii) What do the gradients and y -intercepts of these lines represent in terms of the situation being modelled?

[2]

- (d) The lines representing the equations in part (b) intersect. Use your graphs to write down the approximate coordinates of the intersection point. How can the intersection point be interpreted in this model?

[2]

- (e) Use algebra to solve the two simultaneous equations from part (b). Show each step of your working clearly.

[4]

- (f) State which option gives the better deal, in terms of cost, for different numbers attending.

[2]

- (g) Keith finds out that 18 people are going to attend. If Venue B offers a discount of 20% per person off the entry price (the booking deposit remains the same) when the group size is greater than 15, should this affect Keith's choice for the go-karting day? Justify your answer.

[2]

Question 5 – 20 marks

This question is based on your work on MU123 up to and including Unit 8.

- (a) Figure 2 shows a cuboid and a sphere. Edge AB has length 15 cm, and the diagonal AC has length 30 cm. The radius of the sphere is 12 cm.

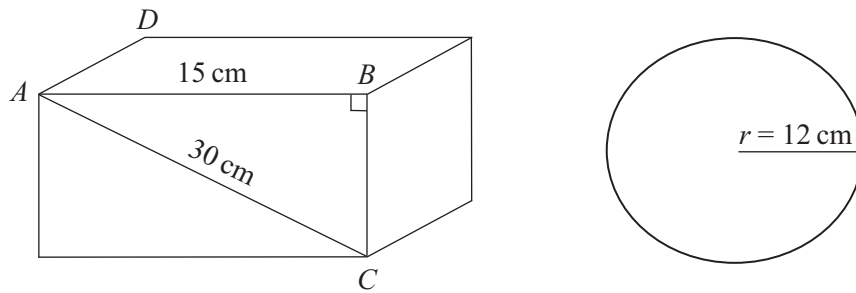


Figure 2

Give your answers to each of the following to two significant figures.

- (i) Find the surface area of the sphere. [2]
- (ii) Find the volume of the sphere. [2]
- (iii) Use Pythagoras' Theorem in triangle ABC to find the length of side BC . [2]
- (iv) If the volume of the sphere is equal to the volume of the cuboid, find the depth AD of the cuboid, showing your working at each stage. [4]
- (v) Find the surface area of the cuboid. [2]

- (b) In this part of the question, you are asked to comment on a student's attempt at answering the question detailed below.

The question

For each of the two pairs of triangles shown in Figure 3, determine (if possible) whether the triangles are congruent, explaining your answers.

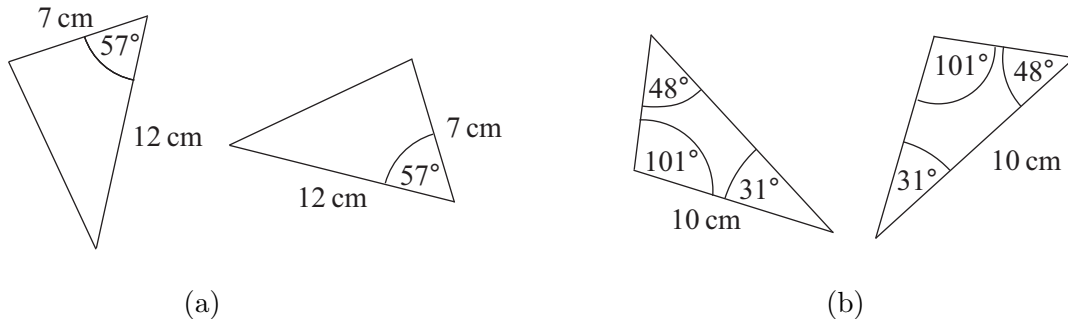


Figure 3

The student's attempt

For pair (a), each triangle has sides of lengths 7 cm and 12 cm with a 57° angle in between, so the two triangles are congruent by SAS.

For pair (b), each triangle has the same three angles, and each triangle has a side of length 10 cm. Therefore the triangles are congruent by ASA.

State whether you agree or disagree with what the student has written for each answer, explaining your reasoning if you disagree.

[4]

- (c) In Figure 4, EF and AG are straight lines. The straight lines AD and BC are parallel. $\angle HAB = 85^\circ$ and $\angle ABH = 43^\circ$. The angles marked θ are equal.

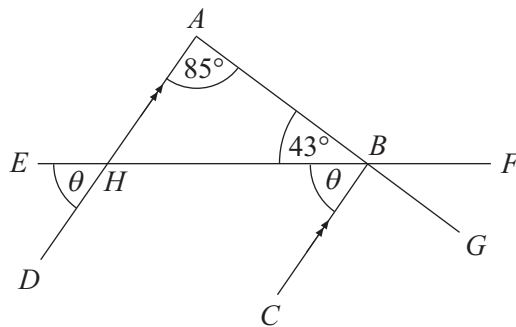


Figure 4

- (i) Explain why the two angles marked θ are equal, and find the value of θ .
 (ii) Find $\angle CBG$, explaining your reasoning.

[2]

[2]

Question 6 – 25 marks

This question is based on your work on MU123 up to and including Unit 9.

- (a) (i) For the arithmetic sequence

$$5, 8, 11, \dots, 41,$$

write down the first term a , the difference d and the last term L , and hence find the number of terms n of the sequence. Check that your answer is correct.

[3]

- (ii) Find the sum of the arithmetic sequence in part (a)(i).

[2]

- (b) Expand the brackets in the following expressions.

(i) $(7x - 9)(9x + 6)$

[2]

(ii) $(4a - 6b)^2$

[2]

- (c) Factorise $9h^2 - 49k^2$.

[2]

- (d) Factorise then solve the quadratic equation $x^2 - 17x - 38 = 0$. Show each step in your reasoning, and check that your solution is correct.

[4]

- (e) A student writes down the following incomplete piece of work.

$$x^2 - 31x = 0$$

Add $31x$ to both sides $x^2 = 31x$

Divide both sides by x $x = 31$

- (i) Substitute $x = 31$ into the left-hand side of the equation $x^2 - 31x = 0$, and explain why this shows that $x = 31$ is indeed a solution of the equation.

[2]

- (ii) Write out a complete solution of the equation $x^2 - 31x = 0$.

[2]

- (iii) Explain, as if directly to the student, why their solution is incomplete.

[1]

- (f) Solve the following equation, checking that your solution is correct:

$$\frac{18}{x-3} = \frac{54}{x+3}.$$

[5]

Question 7 – 5 marks

A score out of 5 marks for good mathematical communication over the entire TMA will be recorded under Question 7.

[5]